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Diagnostic performance of digital breast tomosynthesis with a wide scan angle compared to full-field digital mammography for the detection and characterization of microcalcifications

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ABSTRACT

Objectives: To assess the diagnostic performance of digital breast tomosynthesis (DBT), with a wide scan-angle, compared to full-field digital mammography (FFDM), for the detection and characterization of microcalcifications.
Methods: IRB approval was obtained for this retrospective study. We selected 150 FFDM and DBT (50 benign and 50 malignant histologically verified microcalcifications, 50 cases classified as BI-RADS 1). Four radiologists evaluated, in separate sessions and blinded to patients' history and histology, the presence of microcalcifications. Cases with microcalcifications were assessed for visibility, characteristics, and grade of suspicion using BI-RADS categories. Detection rate and diagnostic performance were calculated. Visibility, lesions' characteristics and reading time were analysed.
Results: Detection rate and visibility were good for both FFDM and DBT, without intra-reader differences ($P = 0.510$). Inter-reader differences were detected ($P < 0.018$). Only two lesions were not detected by any reader on either FFDM or DBT. Diagnostic performance with DBT was as good as that of FFDM, but a significant inter-reader difference was found ($P = 0.041$). High inter-reader variability in the use of the descriptors was found. Reading time for DBT was almost twice that for FFDM (44 and 25 s, respectively).
Conclusion: Wide scan-angle DBT enabled the detection and characterization of microcalcifications with no significant differences from FFDM. Inter-reader variability was seen.

1. Introduction

Digital breast tomosynthesis (DBT) is an increasingly used technique in breast cancer screening and assessment [1–3]. DBT is able to overcome several limitations of mammography, in particular, tissue superimposition due to the acquisition of multiple x-ray projections and the reconstruction of pseudo-tomographic images. Various commercial systems are available at the present time, with different acquisition and reconstruction parameters [4].

Regardless of technical parameters, the added value of DBT in the evaluation of masses, asymmetries, and architectural distortions has been confirmed [5]. However, this does not apply to the assessment of microcalcifications [6]. Microcalcifications are a common finding in the breast that can be caused by benign changes or may represent an early sign of malignant disease [7]. A careful characterization of their morphology and distribution is essential to stratify the risk of malignancy and guide clinical management decisions, such as the need for further diagnostic work-up or standard follow-up [8]. Only a few studies have assessed the value of DBT in the detection and characterization of microcalcifications [9–12]. Kopans et al. [9] reported a very good visibility and good

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Table 1
Histology of the 100 cases selected for the study that presented with microcalcifications.

	Histology	N (%[a])
Benign	Fibrocystic changes	2 (1)
	Fibroadenoma	9 (6)
	Atypical ductal hyperplasia	8 (5)
	Fat necrosis	4 (3)
	Papilloma	3 (2)
	Hyperplasia without atypia	3 (2)
	Sclerosing adenosis	2 (1)
Total benign		50
Malignant	Ductal carcinoma in situ	33 (22)
	Invasive ductal carcinoma	14 (9)
	Invasive lobular carcinoma	3 (2)
Total malignant		50
Total		100

[a] Percentage calculated on the overall number of cases included.

image quality for microcalcifications in a side-by-side evaluation of mammography and DBT. Spangler et al. [10] concluded that digital mammography maintains a higher sensitivity and specificity for microcalcifications, compared to DBT. Tagliafico et al. [12] showed that DBT can miss malignant clusters of microcalcifications that can be easily detected with mammography. These preliminary results opened the discussion about whether DBT is suitable for the study of microcalcifications, a relevant issue that must be considered if DBT is to be used as a primary screening modality [6,12].

It should be noted that the majority of studies that analysed microcalcifications used acquisition parameters characterized by relatively narrow scan angles, and always evaluated DBT in association with 2D imaging [10,12], while data about the evaluation of microcalcifications using DBT with a wide scan-angle alone is still scarce. The scan-angle is the total angular range covered by the projections acquired during the examination. Scan-angle is one of the main acquisition parameters that affect the image quality of DBT, along with the number of projections and their distribution [13,14]. Scan-angle is highly variable in different devices, ranging from 15° (narrow angle) to 50° (wide angle). The optimal combination of the different acquisition parameters is still a topic of intense discussion [13].

The aim of this study was to assess the performance of DBT with a wide scan-angle for the detection and characterization of microcalcifications, and to compare it with full-field digital mammography (FFDM). Inter-reader variability was taken into consideration. Reading time was also measured.

2. Material and methods

2.1. Patient selection

Eligible subjects for this IRB-approved, retrospective study were patients who had undergone digital breast tomosynthesis (DBT) as a screening or diagnostic examination at our institution between January 2010 and August 2012. Overall, 761 patients were examined.

Inclusion criteria used to generate our study cohort were: (a) availability of images from at least one breast with two views in FFDM and DBT examinations; (b) histopathological verification of microcalcifications; and (c) at least two years of negative imaging follow-up for cases classified as BI-RADS 1. Finally, 150 examinations performed in 137 patients (27–87 years of age; mean age, 55 years) were selected (Fig. 1). The study cohort included 50 cases of microcalcifications assessed as benign at image-guided biopsy and 50 cases that were verified to be malignant by histopathology (Table 1). In addition, 50 cases showing no microcalcifications and classified as BI-RADS 1 were selected. This selection process was

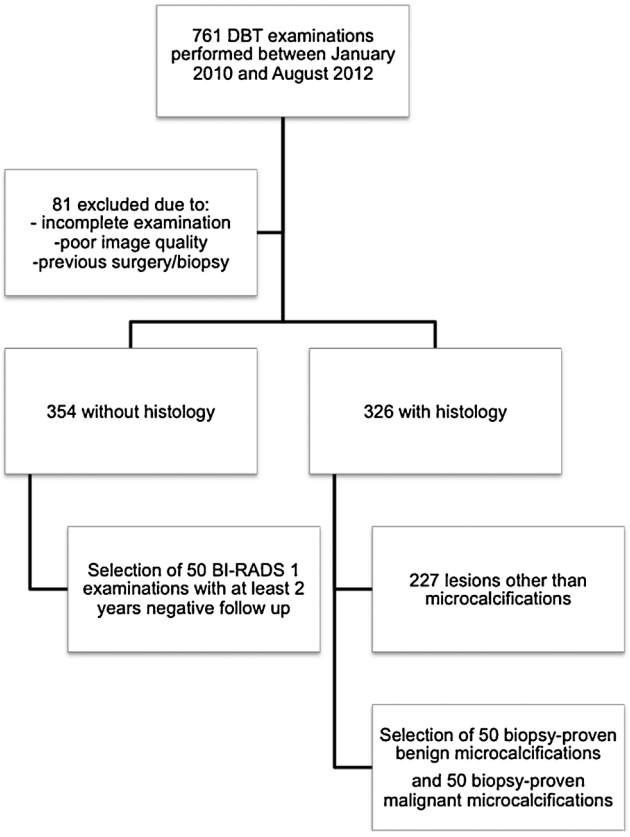

Fig. 1. Flow chart of participants in the study.

chosen to represent a range of lesions and normal confounders usually encountered in the clinical setting. The BI-RADS 1 cases were used as confounders to perform the detection task, and were not further considered in the data analysis. Using the American College of Radiology Breast Imaging reporting and data system (ACR BI-RADS) for density, a predetermined breast density distribution was followed when selecting the cases: 5–10% almost entirely fat (BI-RADS a); 35–40% with scattered areas of fibroglandular density (BI-RADS b); 35–40% heterogeneously dense (BI-RADS c); and 10–15% extremely dense (BI-RADS d). During the selection process, FFDM and DBT were reviewed side-by-side. When FFDM was performed in another facility, care was taken to ensure comparability of the images in terms of breast positioning and lesion location. Finally, 61 one-side FFDM performed in another facility were included. Of the 150 study cohort cases, 124 FFDM and DBT were performed on one breast and 13 were performed on both breasts. Twelve patients had examinations classified as BI-RADS 1 on both sides, while one patient had histologically verified microcalcifications on both sides. Thus, both breasts were included in the study as two different cases.

2.2. Image acquisition

Each case consisted of both FFDM and DBT of at least one breast, acquired in the two standard views (cranio-caudal, CC, and mediolateral oblique, MLO). Additional images (e.g., magnification views) were not included in the current study.

FFDM was performed either in combination with DBT at our institute, or it was performed at other screening facilities. FFDM in other screening facilities was performed on standard devices (Mammomat Inspiration Siemens, Hologic Selenia Dimensions, GE Senographe, Sectra Microdosis Mammography) approved by the